SCIENCE

FRIDAY, JULY 23, 1909

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE DISTRIBUTION OF POISONS IN MUSHROOMS[1]

HISTORICAL INTRODUCTION

EDIBLE and poisonous mushrooms have been of great popular interest from time immemorial, and the earliest histories attest the extensive use to which the harmless varieties were put, both by the peasant population of the world, forced by dire necessity to eat everything that grows, and by the wealthy classes, driven to the same end by the demands of the epicure's palate. Paulet[2] with whose "Traité des champignons" all mycologists must begin their studies, relates that mushrooms have from antiquity been sold, especially during Mid-Lent, in the public markets of Pekin, St. Petersburg, Florence and in other cities and towns in Tuscany. The ancient Babylonians and early Romans employed the edible species in great quantity, and the amanita which seems to me the most beautiful of all agarics, especially when the developing plants are seen in the mountains of North Carolina, the *Amanita cæsaria*, owes its name to a Latin ruler.

The most interesting of the early cases of mushroom or, as commonly described, toadstool poisoning and one of the first authentic cases on record, occurred in the family of the Greek poet Euripedes, who lost in one day, wife, daughter and two sons, who in the poet's absence partook of the deadly species. Among the great ones whose lives were sacrificed to the same ignorance may be mentioned the Pope Clement VII., the Emperor Jovian,

[1] Address delivered before a special meeting of the Boston Mycological Club, June 14, 1909.

[2] Paulet, "Traité des champignons," Paris, 1793.

the Emperor Charles VI., Berronill of Naples and the widow of the Tsar Alexis. The death of the Emperor Claudius is also assigned to this cause, but the reason and the manner of the accident are not certain. It is related that this worthy emperor wishing to rid himself of an uncongenial spouse, disposed of her by one of the many methods suitable for this beneficent purpose, and promptly took unto himself a younger, but alas, no better helpmate. His second choice failed to appreciate the kindly qualities of the emperor and compassed his death by substituting poisonous for edible mushrooms in his favorite meal. According to the pure toxicologists the same end was effected by the simple addition of mineral acid to the agarics served at the emperor's dinner, but as a loyal mycologist, I prefer to believe that the wily woman performed the more skilful trick of substitution.

Next to Paulet, mycologists owe more to Bulliard,[3] the famous French scientist, who was the first to systematically study and classify mushrooms and many of whose species are accepted to-day. We got from him our name "destroying angel" for the *Amanita verna* and modern investigation has but confirmed the conclusions of this fine old savant. In addition to Paulet and Bulliard the list of French authors who have contributed to our knowledge of the toxicology of the subject is long and includes such names as Cordier,[4] Bardy,[5] Gillot,[6] Guillaud,[7] Bourquelot[8] and many others, together with the various contributors to the monthly *Bulletin de la Société Mycologique de France*, now in existence since 1886. Important papers have been published also in Germany, in Italy, in England and in this country, and we now have a very considerable literature of both clinical and scientific interest.

[3] Bulliard, "Histoire des champignons de France," 1791–1812.

[4] Cordier, "Essai sur la toxicité de quelques champignons avant et après leur dessication," Lyon, 1899.

[5] Bardy, *Bull. Soc. Philomat. des Vosges*, 1883–84, 9.

[6] Gillot, "Etude medicale sur l'empoisonement par les champignons," Lyon, 1900.

[7] Guillaud, *Bull. Soc. Mycol. de France*, 1885, 1, p. 123.

[8] Bourquelot, article entitled "Champignons" in Richet's Dict. de phys., Paris, 1898, 3, p. 271.

Amanita Phalloides Bulliard

The "white or deadly amanita" is the cause of the greatest number of the cases of mushroom intoxication, if we include in this group the forms described as *Amanita verna, Amanita bulbosa, Amanita alba, Amanita virescens, Amanita mappa* and many other species known by various names in different localities. The group is indicated in Germany by the designation "Knollen-blätterschwamm." Its description and identification need not concern us at the present time, since there are many deaths on record with the same symptoms during life and identical post-mortem findings which indicate that one species, speaking now from the toxicological point of view, is responsible for the poisoning. The intoxication is characteristic in its course and in its result. The fungi are usually eaten by ignorant individuals, who gather what they find in the woods and consume them either raw or after thorough cooking. A small amount of the fresh material is sufficient to cause profound illness with fatal outcome, so potent is the poison contained in its meshes, and the raw plant seems usually more toxic than the cooked specimens. Two or three "deadly amanitas" suffice to bring on disastrous results, and Plowright[9] reports the death of a child of twelve from eating a third of the pileus of a small raw

[9] Plowright, *Lancet*, December, 1879, Vol. 2, p. 941.

plant. The extreme toxicity of this species illustrates the dangerous consequences which the admixture of two or three specimens to a dish of edible mushrooms entail.

Following the consumption of the fungi there is a period of six to fifteen hours during which no symptoms of poisoning are shown by the victims. This corresponds to the period of incubation of other intoxications or infections. The first sign of trouble is sudden pain of the greatest intensity localized in the abdomen, accompanied by vomiting, thirst and choleraic diarrhœa with mucous and bloody stools. The latter symptom is by no means constant. The pain continues in paroxysms often so severe as to cause the peculiar Hippocratic facies, "la face vulteuse" of the French, and though sometimes ameliorated in character, it usually recurs with greater severity. The patients rapidly lose strength and flesh, their complexion assuming a peculiar yellow tone. After three to four days in children and six to eight in adults the victims sink into a profound coma from which they can not be roused and death soon ends the fearful and useless tragedy. Convulsions rarely if ever occur and when present indicate, I am inclined to believe, a mixed intoxication, specimens of *Amanita muscaria* being eaten with the *phalloides*. The majority of individuals poisoned by the "deadly amanita" die, the mortality varying from 60 to 100 per cent. in various accidents, but recovery is not impossible when small amounts of the fungus are eaten, especially if the stomach be very promptly emptied, either naturally or artificially.

There have been many cases of phalloides intoxication reported in Italy, France, Germany and England, and fatalities from this cause in Canada and the United States are not uncommon. For several years I have collected newspaper accounts of toadstool poisoning and I should estimate that twelve to fifteen deaths occur annually in this country from this species alone. The most horrible of all epidemics ever reported occurred in France at the Orphanage of St. Louis near Pont de la Maye, Gironde, where eleven children died from one meal of *Amanita phalloides* gathered by the ignorant attendants.

TOXICOLOGY OF AMANITA PHALLOIDES

With the earlier investigations of Letellier,[10] published in 1826, probably the first work of a chemical nature upon fungi, of Letellier and Speneux,[11] of Bourdier,[12] of Oré,[13] French mycologists to whom we owe the names *Amanitin, Bulbosine* and *Phalloidin,* we need no longer concern ourselves, not because these men did not have in hand the active principle of *Amanita phalloides* at some time or other, but because the fungi employed by them embraced a number of species and included in all probability *Amanita muscaria.* Muscarine indeed seems to have been present in many of the poisonous extracts which they tested.

Our consideration of the properties of this fungus really must begin with the work of Kobert[14] who was the first to study *Amanita phalloides* in any painstaking manner. From carefully selected specimens of this species he obtained by alcohol precipitation a substance which

[10] Letellier, "Thèse de Paris," 1826.

[11] Letellier and Speneux, *Annales d'hyg. pub. et de med. leg.*, p. 71, 1867.

[12] Boudier, "Des champignons au point de vue de leurs caractères usuels, chimiques et toxicologiques," 1866.

[13] Oré, *Arch. de physiol. norm. et path.* (II.), XI., p. 274, 1877.

[14] Kobert, *St. Petersburger med. Wochenschr.*, XVI., pp. 463, 471, 1891.

had the remarkable property of dissolving red blood corpuscles, a substance known as an *hemolysin,* and which he named phallin. Very minute traces of this substance brought in contact with the red-blood cells of man or with those of many species of animals, produced within a short space of time, fifteen minutes to one or two hours, a complete solution of these corpuscles—a laking of the blood. So powerful was this hemolytic action that even in a dilution of 1–125,000 it was still operative upon the red cells of ox blood. This peculiar phenomenon was so striking that Kobert's attention was naturally riveted upon the substance producing it, since it corresponds so closely to *helvellic acid,* the first hemolytic substance described in fungi, and the active principle of the poisonous helvellas. The fact that phallin was precipitated by ethyl alcohol, resisted dialysis, etc., and that his extracts contained a little coagulable proteid, led Kobert to characterize it as a *toxalbumin,* a name now largely employed by serumologists to indicate a complex poison either itself proteid or so closely bound to proteid, that it must be regarded as proteid or albumin in its chemical nature. Despite certain peculiarities in the behavior of phallin which militated strongly against its acceptance as the active principle of *Amanita phalloides,* especially the destruction of the substance at 70° C., that is, much below the boiling point, Kobert concluded that it was the essential poison of this fungus and stated that the clinical symptoms and the post-mortem changes could be explained by its action. The publication of Kobert that *Amanita phalloides* owed its toxicity to a powerful blood-dissolving substance which, absorbed through the walls of the stomach circulated in the blood plasma, destroying the blood corpuscle as they met it, was a peculiarly enticing explanation for the mysterious phenomena induced by this most powerful of all poisonous fungi, and his explanation was universally accepted, especially in popular treatises on mycology. Kobert,[15] however, continued his study of specimens of *Amanita phalloides* and a few years later announced that the blood-laking principle phallin was occasionally absent from specimens of this species, but that all typical forms contained an alcohol-soluble poison, which killed animals in small doses but did not produce the typical lesions seen in man. This second substance Kobert believed to be a poisonous alkaloid, but gave no satisfactory reason for his characterization of this poison as such.

The second communication of Kobert's had little or no circulation and was never known, I believe, to the majority of mycologists. Personally I was quite ignorant of its existence for some time after I began investigations in this field. During the summer of 1903, now six years ago, I collected a considerable number of specimens of *Amanita phalloides* in Blowing Rock, N. C., only the plants corresponding closely to the classic descriptions and which could be regarded as typical being accepted. During the following winter a careful study of these fungi was instituted. The thoroughly dried material was extracted with distilled water, the extract passed through a Berkefeld filter, and its action studied upon all varieties of blood corpuscles, and upon animals. Subsequently during the summer of 1904 and 1905 I collected in the Blue Ridge Mountains of Maryland and a year later in Woods Holl, Mass. The following season

[15] "Sitzungsberichte der naturforschenden Gesellscheft zu Rostock," p. 26, 1899, Anhang to the *Archiv des Vereins der Freunde der Naturgeschichte in Mecklenberg,* III., 1899, II. Abtheilhung.

Dr. Abel, professor of pharmacology in the Johns Hopkins University, collected in New York state, and then again in New Hampshire. We have thus had a considerable amount of material for study, gathered from widely separated areas.

During the first winter's work[16] I was able to confirm Kobert's assertions as to the presence of a powerful hemolysin in *Amanita phalloides.* I found it acted upon blood corpuscles from nearly every animal tested, and that it corresponded somewhat in its action to hemolysins derived from bacterial filtrates. At the same time it was at once apparent that this fungus always contained another poison which differed from the hemolysin in being resistant to heat and digestion, the blood-laking substance phallin, being destroyed by heating to 70° C., and by the action of the digestive ferments. To this second substance I gave the name amanita-toxin[17] reserving for the blood-laking principle the name amanita-hemolysin, in order to clearly differentiate between these poisons, regardless of any question as to the active principle. The work was now taken up from the chemical standpoint and under Dr. Abel's direction a number of important problems have been solved. In the first place he and I[18] have shown that aqueous extracts of *Amanita phalloides* contain two poisons which may be separated by concentration to a small bulk and precipitation by ethyl alcohol. The precipitate contains the amanita-hemolysin, the filtrate the amanita-toxin. This hemolytic substance we have shown to be not a toxalbumin, as Kobert believes, but a very sensitive glucoside, that is, a substance which contains sugar in its molecule, and which when split up into its component parts will give the most important reactions for sugar, namely, the reduction of Fehling's solution and ammoniacal silver nitrate. Furthermore we[19] have developed a method for the isolation and purification of this substance, and have finally been able to show that it is an extremely complicated poison containing fixed amounts of carbon, nitrogen, hydrogen and sulphur. The importance of these observations lies not only in the practical application of the method we have developed to the examination of other fungi, but also in certain theoretical questions of immunity. This substance is the poison in *Amanita phalloides* to which a high grade of immunity can be established in animals and for which I have repeatedly obtained an anti-poison or an anti-hemolysin, the action of which is to completely neutralize its blood-laking properties.

Schlesinger and I[20] at the same time have shown that the amanita-toxin can be isolated and purified by certain well-defined methods, and in its pure state is one of the most powerful poisons of organic origin known, four tenths of one milligram killing a guinea-pig within twenty-four hours. At first thought to be a conjugate sulphate, I have recently found, in association with Mr. Prouty, that conjugate sulphate can not be split off from the amanita-toxin. The exact character of this poison is still under investigation. These two substances, the amanita-hemolysin and the amanita-toxin, are the only poisons we have thus far encountered in *Amanita phal-*

[16] Ford, *The Journal of Infectious Diseases,* Vol. III., No. 2, April, 1906, pp. 191–224.

[17] Ford, *The Journal of Experimental Medicine,* Vol. VIII., No. 3, May 26, 1906, pp. 437–450.

[18] Abel and Ford, *The Jour. of Biol. Chem.,* Vol. II., No. 4, January, 1907, p. 273.

[19] Abel and Ford, *Arch. f. exp. Path. et Pharm.,* Supplement-Band, Schmiedeberg Festschrift, 1908.

[20] Schlesinger and Ford, *Jour. of Biol. Chem.,* Vol. III., No. 4, September, 1907, p. 279.

loides. The hemolysin we believe to play no rôle in human intoxications, the toxin being the active principle—since it can be boiled and resists the action of the gastric juice. I have furthermore pointed out[21] that the lesions seen in fatal cases of poisoning in man can be reproduced in animals by the amanita-toxin alone, but I am by no means certain that the amanita-hemolysin can be entirely eliminated in human intoxications. This substance is at times present in *Amanita phalloides* in the greatest abundance, and is more resistant to heat than is usually believed. Should the fungi be eaten raw or only partially cooked, this poison might escape the action of the digestive ferments, especially if these be deficient in quantity or quality, and assist the amanita-toxin in its deadly work. Against this possibility we have the fact that *Amanita rubescens,* considered by the majority of mycologists to be an edible mushroom, contains a hemolysin equally powerful with that of *Amanita phalloides.* We can only say that the heat-resistant amanita-toxin is the active principle in the sense that by itself it is capable of causing a fatal intoxication even if the hemolysin is inactive. Nevertheless the fact that the amanita-hemolysin may exert an adjuvant action in cases of poisoning raises at once the question whether fungi containing hemolytic substances should be regarded as entirely safe.

Kobert[22] in the chapter on fungi in his recent text-book ascribes to *Amanita phalloides* first, a blood-laking substance, phallin, which he states to be a toxalbumin despite the observations of Dr. Abel and myself which prove that the hemolysin in this fungus is a glucoside, secondly, an alcohol-soluble poison, not producing fatty degeneration, which he believes to be an alkaloid, and finally a third hypothetical poison, a toxalbumin like thujon and pulegon, certain complex substances found in plants (pennyroyal). In the second poison Kobert is probably dealing with the amanita-toxin, which is not an alkaloid and which I think does produce fatty degeneration, and his third poison is purely supposititious. He himself presents no evidence of its existence, and while we can not deny that *Amanita phalloides* may contain at times other poisons not noted by us, we are inclined to the opinion that the amanita-hemolysin and the amanita-toxin are the most important, if not the only ones.

Specimens of small amanitas collected in the Blue Ridge Mountains of Maryland and identified as *Amanita verna* Bulliard were presented in special lots. When examined their properties were quite the same as those of *Amanita phalloides.* The strength of both hemolysin and toxin, however, was considerably greater when the weight of the dried specimens was considered.

Amanita muscaria Linnæus

The species known as the "fly agaric" (Fliegenpilz or Fliegenschwamm of the Germans) has been recognized from early times as deadly poisonous, the first accident on record being possibly that of Madame the Princess of Conti in Fontainebleau in 1751. This, however, did not terminate fatally. *Amanita muscaria* is a beautiful species when fully developed and to a certain extent it resembles *Amanita cæsaria* or *Amanita aurantiaca,* French writers distinguishing between the two species by referring to the edible form as the "oronge vraie" and to the poison-

[21] Ford, *Jour. of Infect. Dis.,* Vol. 5, No. 2, March 30, 1908, pp. 116–132.

[22] Kobert, "Lehrbuch der Intoxikationen," Zweite Aufl., II², p. 625, 1906.

ous species as the "oronge fausse." It can easily be recognized by even beginners in mycology and is now commonly avoided. Poisoning results from ignorance, the species in question being selected for its beautiful color and form, or from mistakes in identification, *Amanita muscaria* being taken for the *cæsaria* or the *aurantiaca*. In addition there is another factor which is possibly the cause of the majority of accidents in this country, especially those occurring with individuals possessing some knowledge of mycology. In Italy and in France and in certain parts of Austro-Hungary *Amanita muscaria* is apparently somewhat reddish in color, while *Amanita cæsaria* is of a lighter yellow tone. The most commonly found *Amanita muscaria* in this country is of a light to a deep yellow in color, not showing the reddish tinge, while *Amanita cæsaria* is either of the reddish-yellow hue or even of a beautiful reddish-brown.

Persons familiar with the two species in the old world might very easily draw wrong conclusions in identifying those found in the new. I base this opinion largely upon a comparison of the colored plates of the text-books of mycology published in different countries and upon the specimens of "Cæsar's agaric" and the "fly agaric" I have myself found in the Blue Ridge Mountains. This assumption is furthermore borne out somewhat by the literature of "muscaria poisoning" for in many instances the victims were Italians or Poles who stated before death that they ate the fungi under the impression that they were eating the "royal agaric." This was apparently the cause of the poisoning of the Count de Vecchi and his physician in Washington whicb Prentiss[23] has reported with great care. The Count, an attaché of the Italian legation, a cultivated gentleman of nearly sixty years of age, considered something of an expert upon mycology, purchased, near one of the markets in Washington, a quantity of fungi recognized by him as an edible mushroom. The plants were collected in Virginia about seven miles from the city of Washington. The following Sunday morning the count and his physician, a warm personal friend, breakfasted together upon these mushrooms, commenting upon their agreeable and even delicious flavor. Breakfast was concluded at half after eight and within fifteen minutes the count felt symptoms of serious illness. So rapid was the onset that by nine o'clock he was found prostrate on his bed, oppressed by the sense of impending doom. He rapidly developed blindness, trismus, difficulty in swallowing and shortly lost consciousness. Terrific convulsions then supervened, so violent in character as to break the bed upon which he was placed. Despite rigorous treatment and the administration of morphine and atropine, the count never recovered consciousness and died on the day following the accident. The count's physician on returning to his office was also attacked, dizziness and ocular symptoms warning him of the nature of the trouble. Energetic treatment with apomorphine and atropine was at once instituted by his colleagues and for a period of five hours he lay in a state of coma with occasional periods of lucidity. The grave symptoms were ameliorated and recovery set in somewhere near seven o'clock in the evening. His convalescence was uneventful, his restoration to health complete, and he is, I believe, still living. In this instance the count probably identified the fungi as *cæsaria* or *aurantiaca*. From the symp-

[23] Prentiss, *Phil. Med. Jour.*, 1898, 2, pp. 607–611.

toms and termination the species eaten must have been *muscaria.*

These two cases are not typical of this intoxication. In the majority of instances *Amanita muscaria* has a bitter, unpleasant taste and on this account is not eaten in great quantity. Consequently the intoxication is not so profound and the fatalities are fewer in number. Moreover the action of the poison is mainly directed against the nerve centers and if this action be neutralized by atropine, or if the nerve centers are not completely overwhelmed, its effect gradually wears off, without any permanent lesion. Not so with *Amanita phalloides,* where the amanita-toxin is the cause of such profound degeneration in the internal organs, heart, kidney and muscles, as to make recovery a far more arduous task for nature to accomplish.

The active principle of *Amanita muscaria* is muscarine, an alcohol-soluble crystalline substance first isolated from this species by Schmiedeberg and Koppe[24] and usually classed with the ammonia bases. It will reproduce in animals the intoxication seen in man and is without doubt the chief poison present. Muscarine has also been prepared synthetically, by the oxidation of choline, but the artificial body does not produce quite the same symptoms and it is easily decomposed. Moreover muscarine is apparently not the only poison present in this plant. It has been shown on clinical grounds that even when this drug is completely neutralized by its perfect physiological antidote, atropine, the patients who have eaten *Amanita muscaria* sometimes die, and Harmsen, from a series of carefully conducted experiments, concludes that another poison exists in *Amanita muscaria,* the so-called "Pilztoxin." This fungus is probably most widely known from the habits of the peasants of the Caucasus who prepare from it an intoxicating beverage which produces wildly riotous drunkenness. Death from a muscarine orgy is not uncommon in this part of Russia and a member of the ruling family is said to have lost his life in that way. *Amanita muscaria* collected in the Caucasus is said to be deficient in muscarine, but the universal testimony of medical writers would indicate that this is not the case, but that rather a kind of tolerance develops among the habitual users of the *muscaria* decoctions. We do not know, however, whether muscarine is present in *Amanita muscaria* in the same quantity at different periods of the year nor have we any knowledge of the effect of soil and climate upon its distribution. The only antidote for this poisoning is atropine, which, however, is so potent in this respect as to almost completely neutralize the muscarine and hence the outlook in this intoxication is far more hopeful than in any other.

[24] Schmiedeberg and Koppe, "Das Muskarin," Leipzig, 1869.

RARELY POISONOUS SPECIES

Amanita pantherina De Candolle, a species closely resembling *Amanita muscaria,* is occasionally the cause of mushroom poisoning, but the intoxication is not profound and but rarely does death ensue. The symptoms come on within a few hours after eating, and consist of great excitement, delirium, convulsions and a peculiar drunkenness not unlike that described among the Koraks. The Japanese variety is said by Inoko[25] to represent *Amanita muscaria* for Japan, being used there as a fly poison in place of the latter species, which is rare and devoid of any poisonous quality. Inoko has isolated muscarine from this Japanese *Amanita pantherina*

[25] Inoko, *Mittheil. a. d. Med. Fac. de K. Jap. Univ. Tok.,* 1890, 1, No. 4, pp. 313–331.

and has reported an extensive series of intoxications. The victims showed in addition to vomiting, diarrhœa, and a dilatation of the pupils, peculiar nervous manifestations. The feeling of "bien-être" expressed by singing and laughing, the sensation as of insects crawling over the skin, visions of beautifully colored reptiles and snakes, red, yellow and brown, all contribute to give us a picture of a peculiar mental state, which differs from that described among the Russians, not so much in the kind of drug causing the symptoms as in the different psychology of the Oriental as compared with the Tartar. In all cases the intoxication with *Amanita pantherina* is mild and recovery the rule.

The poisonous fungus *Helvella* or *Gyromytra esculenta* Fries occurs so rarely in this country and is so seldom the reputed cause of illness at the present time, that we need not pay any particular attention to it beyond referring to its active principle, Helvellic acid, isolated by Boehm and Külz.[26] This is a hemolytic or blood-destroying substance, soluble in hot water, which when given to dogs by mouth will reproduce the lesions found in man with all the signs of a hemolytic intoxication. Other species of mushrooms like *Russula emetica* cause profound gastro-intestinal disturbances such as a sharp attack of vomiting and diarrhœa, recovery following emptying of the stomach and bowel of the irritating plant. Certain of the rank-smelling phalloideæ which exhale an offensive odor and are of course never eaten by man, are eagerly devoured by swine with uniformly fatal consequences. Gillot (*l. c.*) states that one or two species of *Volvaria* have caused death when eaten, but nothing is known of the nature of the intoxication or of the active principle.

[26] Boehm and Külz, *Arch. f. exp. Path. u. Pharm.*, 1885, 19, p. 403.

Finally the poisonous *Boletus luridus* or *Boletus satanus* may occasionally be the cause of transient disturbances in man, but the plants have such a rank, unpleasant taste as to forbid their consumption in any quantity. These species have been said to owe their toxicity to muscarine. The question as to whether the ordinary edible mushrooms, as distinguished from the poisonous toadstools, may not in certain localities or at certain periods of the year be the cause of fatal intoxication, may be answered, I am sure, in the negative. Old or badly decomposed specimens may cause transient illness, and I remember well an attack of cholera-morbus which I experienced in Paris from eating dried specimens of the meadow mushroom, purchased in the open market. There are, however, no authentic cases of *poisoning* from the black or brown spored agarics and when investigated in the laboratory, these species are found free from toxins. The three or four forms already mentioned are the only ones thus far *proved* to be poisonous and the only ones with which laboratory investigation has confirmed clinical observation.

In addition to *Amanita phalloides* and *Amanita verna,* I have also analyzed *Amanita rubescens* Persoon[27] collected at Woods Holl, Mass., and a species from the same place which I identified as *Amanita solitaria* Bulliard. It corresponded closely in its general appearance to the plates and descriptions given for this species. In *Amanita rubescens* I found a powerful blood-destroying substance like the amanita-hemolysin which could be freed from proteid and which gave the reactions for glucosides. *Amanita solitaria* had a peculiar action upon blood corpuscles, causing their agglomeration in densely adherent

[27] Ford, *Jour. of Infect. Dis.*, Vol. 4, No. 3, June, 1907, pp. 434–439.

clumps, the phenomenon spoken of in bacteriology as *agglutination,* but in addition the corpuscles were slowly dissolved. Neither species contained any amanitatoxin. Both *Amanita solitaria* and *Amanita rubescens* are regarded by mycologists as edible. If they can be eaten by man, these substances acting "in vitro" upon the blood corpuscles must either be destroyed in cooking or be digested in the stomach and intestines, or the species must vary in their properties.

SPECIES COLLECTED IN 1908

For a long time I had been anxious to examine some of the rarer species of fungi which closely resemble the deadly poisonous forms, and also some of the species which are said to be *dangerous,* occasional intoxications from their use having been reported in the older literature. The opportunity of doing so was afforded me through the kindness of Mr. George E. Morris, of Waltham, Mass., who sent me last fall a number of fungi which he had himself procured, together with specimens collected by Mr. Simon Davis, of Brookline, Mass., and some from the general collection of the Boston Mycological Club. These mushrooms were accurately identified in the fresh state, carefully dried in a drying oven, wrapped in separate packages, labeled with the name of the finder and the place and date of finding. The specimens were analyzed "seriatim" in the laboratory. The results of this work will be reported in detail later, but tonight the principal conclusions drawn from the study of these forms may be briefly commented upon. It is essential, when looking into the properties of the rarer fungi, especially the amanitas, that the various species studied should have been identified by expert botanists, and I feel very fortunate in this respect in having material vouched for by such well-known mycologists. One species of *Amanita phalloides* obtained by Mr. Davis at Stow was found to contain the poisons typical of this species. Their strength was somewhat less than usual, but the action upon blood corpuscles and upon animals was identical with that usually found. Two lots of *Amanita virosa* Fries were examined: one obtained by Mr. Morris in Cohassett, and another by Mr. Davis in Stow. In both instances hæmolysin and toxin were present in maximum quantities. An extract of fungus in which the dried material was utilized in the proportion of six grams to fifty cubic centimeters of water gave a hemolysin active in a dilution of 1–200, and subcutaneous injection of the extract killed guinea pigs within twenty-four hours with the symptoms and lesions of an acute intoxication. *Amanita virosa* thus is identical with *Amanita phalloides.* Specimens of *Amanita spreta* Peck collected by Mr. Morris in Stow and by Mr. Davis in the same locality were identical in their action. In the proporton of six grams of dried fungi to sixty cubic centimeters of water a hemolysin was present in both instances, in a strength of 1–20 and the inoculation of animals with the heated extract produced a typical chronic intoxication. While the poisons are by no means as powerful as those in *Amanita virosa* they are of the same character. *Amanita spreta* is described by Atkinson[28] with the words "said to be poisonous." Although no cases of intoxication have thus far been reported in the literature, the species must be classed with the "deadly poisonous." *Amanita phalloides* Bulliard, *Amanita verna* Bulliard, *Amanita virosa* Fries and *Amanita spreta* Peck, may thus be grouped

[28] Atkinson, "Mushrooms," 1903, p. 69.

together in their toxicological properties. *Amanita rubescens* Persoon from the collection of Mr. Morris at Stow and a yellow form of *Amanita rubescens* from the Boston Mycological Club were examined by the routine method. The *rubescens* from Mr. Morris's collection was devoid of hemolysin and toxin alike, while the yellow form contained an active hemolysin but no toxin. A more careful study of the species *rubescens* must be made before a positive conclusion can be drawn concerning its properties. Four of the rarer species of *Amanita* may be described together because of their similarity, namely, *Amanita strobiliformis* Vittadini found by Mr. Morris in Ellis, *Amanita chlorinosma* Peck from the collection of the Boston Mycological Club, *Amanita radicata* Peck found by Mr. Morris in Ellis and *Amanita porphyria* Albertini and Sweinitz from the same place.

These four species were alike devoid of hemolysins, but contained in small quantities a poison which is practically identical with the amanita-toxin. It is resistant to heat, soluble in alcohol and kills animals slowly, but with many of the lesions found in phalloides poisoning. These fungi should all be considered "deadly poisonous," and future experience may even show that hemolysins are also present in other forms of the same species, in which case they would be practically identical with the "deadly amanita."

Two specimens of *Amanita muscaria* Linnæus were given me, one found by Mr. Morris and the other by Mr. Davis in Stow. The properties of these forms were identical with those of *Amanita muscaria* obtained for me six years ago by Dr. W. H. Lewis, in Woods Holl, Mass. The species thus seems very constant in its characteristics. All three samples contained muscarine, the aqueous and alcoholic extracts killing animals in two hours with the usual symptoms. The alcoholic extract contained in addition a peculiar hemolysin, the properties of which are still under investigation, while in the aqueous extract evaporated to a small bulk and precipitated by ethyl alcohol I found an *agglutinin* such as has been previously described for *Amanita solitaria*. The development of our methods of analyzing fungi enabled me to *isolate* this substance, which turned out to be a glucoside, but not one containing pentose. Although agglutinins are not uncommon in various plants, this is, I believe, the first time that one has been isolated by chemical methods, and the first time that a glucoside has been found to exert this action upon blood corpuscles.

Amanita frostiana Peck, three specimens of which were found by Mr. Morris in Stow and one at Cohasset were individually examined. They contained in all instances an hemolysin of low grade intensity, but the heated extracts were without action upon animals. Neither amanita-toxin nor muscarine could be demonstrated. The absence of resistant poisons from this species is particularly interesting since *Amanita frostiana* was first described by Peck as a minor variety of *Amanita muscaria,* and is put down by Atkinson[29] as "poisonous." The specimens sent me were certainly devoid of muscarine, a fact which suggests that the species may not be so closely related to *Amanita muscaria* as is indicated by its botanical characters. Further observations must be made with other forms of *Amanita frostiana* to determine whether it is uniformly free from the poison described by Schmiedeberg. Finally three specimens of *Amanita russuloides* Peck, one found at Natick by Mr. Morris, another at Stow by Mr. Morris, and a third at

[29] Atkinson, "Mushrooms," 1903, p. 54.

Stow by Mr. Davis proved to be quite free from poisons of any description. In one instance a slight hemolytic action was observed, but this was attributed to the acid reaction of the fungus. In all cases the heated extracts were without effect upon animals. This species is considered edible by most mycologists.

GENERAL CONCLUSIONS

The examination of these various species of fungi, representing now nearly twenty distinct forms, demonstrates one or two facts which should be particularly emphasized. In the first place, our methods of chemical analysis of mushrooms, and especially the methods of isolating their poisons are now so developed that a little material, two or three small specimens in fact, and even one good sized plant, may be studied and an opinion be given as to the properties of the species. In the second place, a more extended investigation should be carried out in regard to the properties of all the mushrooms believed on clinical grounds to be poisonous, but of which no laboratory study has thus far been made. Finally such a piece of work, to be of lasting value to science, can only be accomplished through the cooperation of trained mycologists who can identify with certainty the species of mushrooms selected for study.

William W. Ford

Bacteriological Laboratory,
Johns Hopkins University,
June 20, 1909

NOTES ON ELECTRICAL ENGINEERING AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

The cause of electrical engineering research and the advanced instruction of graduate students in electrical engineering has been advanced by the appointment of Dr. Harold Pender to the professorship of theoretical and applied electricity which is connected with the department of electrical engineering at the Massachusetts Institute of Technology. Dr. Pender is a graduate of Johns Hopkins University and took the degree of Ph.D. at that university in 1901 under the direction of Professor Rowland. He thereafter taught for a year and a half, during which period he completed the classical experiments of Professor Rowland which demonstrated the magnetic effect of a moving charge of electricity. M. Poincaré having suggested the desirability of these experiments being performed in Paris, the Carnegie Institution of Washington arranged with Dr. Pender to go to France for the purpose. Upon returning from France Dr. Pender went into the employ of the Westinghouse Electric Company and he has since been in regular engineering employ. His teaching at the Institute of Technology will consist of a course for third-year undergraduate students and courses for graduate students in the more advanced theories of electric current flow and the electric transmission of power, in addition to the direction of experimental research by advanced students.

The advanced lectures on the organization and administration of public service companies, on the design of power stations and systems, and on electrical measurements heretofore carried on by Professor Jackson, Professor Shaad and Professor Laws will be continued by the same professors.

As indicating the trend of electrical engineering study at the present time, it is notable that forty per cent. of the students just graduated from the electrical engineering course at the Massachusetts Institute of Technology already bore degrees of bachelor of arts or science, conferred, as a rule, in classical or literary courses. These men are going into a wide variety of activities, from the manufacture of electric instruments and of incandescent lamps to electric transmission of power and heavy electric traction.

Mr. H. S. Osborne and Mr. W. S. Rodman, who are candidates for the degree of doctor of engineering in the electrical engineering department, have recently been appointed fellows by the faculty of the institute. Mr. R. L. Jones has been appointed graduate scholar in electrical engineering.

EDUCATIONAL SECTION OF THE BRITISH ASSOCIATION

THE section will assemble on Thursday, August 26, in the Senate House of the University of Manitoba, Winnipeg, under the presidency of the Rev. H. B. Gray, D.D., Warden of Bradfield. After the president's address a discussion on moral instruction in schools will be opened by Professor L. P. Jacks, editor of the *Hibbert Journal*. He will be followed by Mr. Hugh Richardson, of the Friends' School, Bootham, York, and it is hoped that American and Canadian educationists will also take part.

On Friday, the twenty-seventh, there will be a discussion on practical work in schools, which will be opened on behalf of the subcommittee of the association which is now considering the question, by Mr. W. M. Heller, chief inspector of science work under the commissioners for elementary education in Ireland. Dr. C. W. Kimmins, vice-president of the section and chief inspector of schools under the London County Council, will contribute some account of the London Trades Schools. Miss Lilian J. Clarke, of the James Allen School, Dulwich, examiner in the University of London, will speak on practical work in girls' secondary schools, and Mr. W. Hewitt, director of technical education in Liverpool, on practical work in evening and continuation schools.

On Monday, the thirtieth, there will be a joint meeting with the Geographical Section of the association for the discussion of geography teaching. Professor R. E. Dodge, of Columbia, and Professor G. G. Chisholm, of Edinburgh, are expected to open the discussion. There will also be a discussion on the relations of universities and secondary schools, with special reference to the accrediting and examining systems.

On Tuesday the president of the section will open a discussion on education as a preparation for agricultural life, with special reference to Canadian conditions. If time permits it is also intended to discuss the subject of consolidation schools.

The committee of the section are in correspondence with educationists in Canada and America, and they hope to arrange that each subject shall be opened by representatives of American, Canadian and British education. American educationists who may be attending the meeting of the association will be welcomed at the sectional meeting.

The local secretary for the meeting is Mr. D. M. Duncan, of the University of Manitoba, Winnipeg, and the recorder is Mr. J. L. Holland, secretary for education in Northamptonshire, of Northampton, England. Offers of contributions on any of the subjects set for discussion may be made to either of these gentlemen, and will be considered by the committee of the section.

SCIENTIFIC NOTES AND NEWS

A PORTRAIT of Dr. J. W. Mallet, professor of chemistry in the University of Virginia, has been presented to the university by his former students. It is the work of Mr. Duncan Smith, a son of Dr. Mallet's colleague and life-long friend, Professor Francis H. Smith.

SIR JOSEPH DALTON HOOKER celebrated his ninety-second birthday on June 30. His scientific career began seventy years ago, when he went out as surgeon and naturalist with Sir James Ross's Antarctic expedition.

DR. C. GORDON HEWITT, lecturer in economic zoology in the University of Manchester, has been appointed entomologist to the Dominion of Canada in succession to the late Dr. James Fletcher.

DR. E. F. NICHOLS, professor of physics at Columbia University, assumed the presidency of Dartmouth College on July 15. The formal installation will take place in October.

PROFESSOR KARL RUNGE, of the department of mathematics in the University of Göttingen, has been appointed Kaiser Wilhelm professor at Columbia University for next year.

THE Fritz Schaudinn medal for work in microbiology has been awarded to Dr. Stanislaus von Lanow, Schaudinn's successor in the Hamburg Institute for Marine and Tropical Diseases.

Dr. W. Stirling, professor of physiology in the University of Manchester, has been elected a foreign corresponding member of the Turin Academy of Medicine.

We learn from *Nature* that the council of the Royal Society has awarded the Mackinnon studentships for the year 1909 as follows: one in physics to Mr. R. D. Kleeman, of Emmanuel College, Cambridge, for the continuation of his researches on radio-activity, which he proposes to conduct at the universities of Cambridge, Leeds and Manchester; the other, in biology, has been renewed for a second year to Mr. D. Thoday, of Trinity College, Cambridge, for research into the physiological conditions of starvation in plants and its relation to the responsiveness of protoplasm to stimulation, especially to stimuli affecting respiration.

Professor J. H. Jeans, whose resignation from the chair of mathematics at Princeton University has been announced, will return to his home in Cambridge, England.

Mr. H. C. Sims, of the Field Museum of Natural History, has started for the Ilongo country in the Philippines to continue the work which was interrupted by the death of Dr. William Jones.

Professor Charles E. Bessey, of the University of Nebraska, is giving a course of lectures at the Marine Station at Orcas Island at Olga on Puget Sound. During August he expects to join Professor E. A. Bessey in a botanizing expedition in the Rocky Mountains.

Professor William H. Hobbs, of the University of Michigan, expects to join Professor Tarr and Professor Martin in the Yakutat Bay region of Alaska and afterwards to attend the Winnipeg meeting of the British Association.

Dr. Roland B. Dixon, assistant professor of anthropology in Harvard University, is spending the summer in New Zealand and Australia.

Dr. R. M. Strong, of the department of zoology of the University of Chicago, will sail for Europe on August 7. He plans to return about the end of March, 1910.

The magnetic survey yacht *Carnegie* will leave New York early in August for a cruise of six to seven months embracing Hudson Bay, the North Atlantic and return via Madeira and Bermuda. Mr. W. G. Peters will be in command, Captain C. E. Littlefield, the sailing master, Dr. C. C. Craft, surgeon and observer, Messrs. J. T. Ault, E. Kidson and R. R. Tafel, magnetic observers, and F. D. Smith, observer-engineer. Besides the scientific party and the sailing master, the *Carnegie* carries a crew consisting of two watch officers, eight seamen and two cooks. The director, Dr. L. A. Bauer, will accompany the vessel as far as St. Johns, Newfoundland, and possibly to some point in Labrador. Mr. D. F. Smith, graduate of the University of Maine, 1905, and connected for the past three years with the Technologic Branch of the U. S. Geological Survey as expert on gas engines and gas producers, has been appointed observer-engineer on the *Carnegie*. He will have special charge of the machinery installation. The *Carnegie* is equipped with a four-cylinder Craig internal combustion engine of 150 horse power, sufficient to drive the vessel six knots in calm weather. The gas producer was furnished by the Marine Producer Gas Co., of New York. Both the engine and the producer are constructed practically of non-magnetic materials.

The Joseph Eichberg fund for the establishment of a memorial chair of physiology in the medical department of the University of Cincinnati, now amounts to $45,000.

The *Journal of the American Medical Association* states that a memorial to Kussmaul was unveiled at Freiburg, May 15, with much ceremony, and the German journals of the first week in June contain views of the bust that surmounts the shaft and the allegorical figure on the base representing the art of healing. A tablet to Auenbrugger, the "father of percussion," has also recently been installed at Vienna, and a large statue of Pettenkofer unveiled at Munich. A memorial to Mikulicz was also unveiled at Breslau on May 27; it stands in front of the clinic he made famous, and the address was delivered by his successor,

H. Küttner. In Madrid, also, a tablet was installed in the Colegio de Medicos the same week, to the memory of F. G. Roel, noted in connection with the first description of pellagra. His will is said to be such an interesting document that the Academy of Medicine is to republish it shortly.

JOHN MORSE ORDWAY, until three years ago professor of metallurgy at Tulane University, has died, at the age of eighty-six years.

MR. LEFFERTS BUCK, an engineer known especially for his work on bridges, died in his home in Hastings, N. Y., on July 17, at the age of seventy-two years.

THE deaths are also announced of Dr. Frank Kelton Bailey, instructor in physics in the Ohio State University, and of Dr. Theodore R. Wolf, professor of chemistry in Delaware College.

DR. T. W. BRIDGE, F.R.S., professor of zoology at the University of Birmingham, known for his work on ganoid fishes and teleosts, died on June 30, at the age of sixty-one years.

DR. VITTORIO RAFFAELE MATTEUCCI, director of the Royal Observatory on Mt. Vesuvius, well known for his studies in seismology, died on July 16, at the age of forty-nine years.

THE heirs of the late Herr Heinrich Lanz, head of the Mannheim engineering firm, have given a million Marks for the establishment of an academy of sciences at Heidelberg.

THE local secretaries for the forthcoming British Association meeting at Winnipeg desire to point out that the proposed excursion up the coast of British Columbia to Alaska, now being organized in connection with the Natural History Society of Canada, is unofficial and is not part of the local committee's arrangements. Those desiring, therefore, to make this journey before the meeting should communicate with Moses B. Cotsworth, Victoria, B. C.

THE annual meeting of the British Medical Association will begin in Belfast next week. On July 27, Sir William Whitla will be inducted into the office of president by Mr. Sinclair White and will deliver his address.

A NEW society has been formed in Great Britain, known as the Institution of Mining Electrical Engineers. Local sections have been established at Newcastle and for the Glasgow district of Scotland. The first general meeting of the society will be held in September.

M. G. DARBOUX has been reelected president of the Société des Amis des Sciences, MM. Aucoc and Picard vice-presidents and Professor Joubin general secretary. *Nature* states that the society was founded in 1857 by Baron Thenard with the view of assisting unfortunate inventors, men of science and professors and their families. Among the names of past-presidents of the society occur those of Thenard, J. B. Dumas, Pasteur and others. Since its foundation the society has distributed in pensions and grants more than two and a half million francs. This year eighty pensions have been granted to aged scientific men or their widows. The society has assisted the education of some seventy children and has made grants to thirty-five widows.

THE *Medical Record* states that plans have been completed for the new psychiatric ward of the Johns Hopkins Hospital which is to be built by Mr. Henry Phipps, of New York. The building will be of dark brick and stone to resemble the other buildings of the hospital, but the interior will be quite different from the usual hospital ward. The white coloring common to hospitals will be omitted, and the rooms will be made as homelike as possible. The idea of non-restraint will be carried out as much as possible. The court will be made into a garden, and the windows will be guarded by flower boxes and trellises instead of bars. Extensive arrangements for recreation and exercise will be supplied.

A COOPERATIVE soil survey of Wisconsin is soon to be begun under the direction of the state Geological and Natural History Survey and the College of Agriculture of the University of Wisconsin, assisted by the Bureau of

Soils of the U. S. Department of Agriculture. An act passed by the last legislature provides that a soil survey and a soil map of the state be made to ascertain the character and fertility of the developed and undeveloped soils of the state, the extent and practicability of drainage of swamp and wet lands and the means for conserving and increasing the fertility of the soils. The sum of $10,000 annually is appropriated for the next two years for this work.

According to the London *Times* an ascertained commercial value of £4 per milligram (equivalent to £114,000 per ounce) has been placed upon radium by a contract just entered into between the British Metalliferous Mines (Limited) and Lord Iveagh and Sir Ernest Cassel for the supply of 7½ grams (rather more than a quarter of an ounce) of pure radium bromide. This very large order for radium will be supplied from the above named company's mine near Grampound Road in Cornwall. In the short history of radium there has never hitherto been known any greater order than a gram. The first recorded order on a large scale will therefore be supplied from the British source from which several of the smaller orders have already been supplied. Messrs. Buchler and Co., of Brunswick, will produce the radium from the Cornish pitchblende under the superintendence of Professor Giesel, their chief chemist. The 7½ grams of radium referred to are to be presented by Lord Iveagh and Sir Ernest Cassel to the Radium Institute, to the formation of which they have already contributed very large funds. The Radium Institute, which will be under the surgical direction of Sir Frederick Treves, is expected to be ready to receive patients suffering from cancer about the end of the present year.

UNIVERSITY AND EDUCATIONAL NEWS

M. Henry Deutsch has given 500,000 francs, and promises in addition an annual grant of 15,000 francs, towards the creation of an aerotechnical institute in the University of Paris.

M. Basil Zakaroff has given 700,000 francs for the foundation of a chair of aviation in the faculty of sciences of the university.

A college of mining engineering has been established at the University of Illinois. The Western Society of Engineers was instrumental in inducing the legislature to make the necessary appropriations. A committee for that purpose composed of F. A. Delano, Bion J. Arnold, John M. Ewen, Isham Randolph, Robert W. Hunt and A. Bement was appointed by the society.

At the summer school of Columbia University there are about 1,930 students, about 400 more than were registered last year. In 1908 registration was 1,532, in 1907, 1,200, in 1906 1,000. The 1909 registration does not include the thirty medical students who are attending lectures, nor the 300 undergraduates who are taking the regular summer engineering courses at Camp Columbia, Washington, Conn.

The College of Agriculture of the University of Wisconsin has established a department of agricultural economics in charge of Professor Henry C. Taylor.

The following appointments have been made in the medical department of Cornell University: Dr. Frank Sherman Meara, professor of therapeutics and clinical medicine; Dr. Charles N. B. Camac, professor of clinical medicine; Dr. William J. Elser, professor of bacteriology; Dr. John A. Hartwell, professor of clinical surgery; Dr. William B. Coley, professor of clinical surgery; Dr. Silas P. Beebe, assistant professor of experimental therapeutics, and Dr. John R. Murlin, assistant professor of physiology.

Dr. Ralph S. Minor, professor of physics at the University of Nevada, has accepted an associate professorship of physics in charge of the lower division work at the University of California. The position in Nevada has been filled by the appointment of Professor Leon W. Hartman who, for the last four years, has been associate professor of physics in charge of the department at the University of Utah.

DR. W. H. SHELDON, preceptor of philosophy at Princeton University, has been elected professor of philosophy at Dartmouth College.

DR. HARDEE CHAMBLISS, of the research staff of the General Chemical Company, New York, has accepted the professorship of chemistry in the Oklahoma Agricultural and Mechanical College at Stillwater, Okla.

MR. BENJAMIN F. LUTMAN, assistant in botany at the University of Wisconsin, has been appointed assistant botanist in the Agricultural College of the University of Vermont.

DR. J. ELIOT COIT, of the University of Arizona, has accepted the assistant professorship of pomology in the University of California.

IN the department of zoology at Northwestern University, Dr. E. H. Harper has been promoted to an assistant professorship and Charles S. Mead, Ph.D. (Columbia), has been appointed instructor in zoology.

PROFESSOR JOHN COX has retired after nineteen years as Macdonald professor of physics in McGill University and first director of the Macdonald Physics Building. Professor H. T. Barnes has been appointed director and Professor H. A. Wilson, F.R.S., has been appointed Macdonald professor of physics. Dr. H. L. Brown has been appointed assistant professor of physics, Mr. F. H. Day and Mr. W. R. Gillis, lecturers in physics, Mr. A. L. Dickieson, Mr. N. E. Wheeler and Mr. A. G. Hatcher, demonstrators in physics.

IN the Queen's University of Belfast appointments have been made as follows: professor of botany, Mr. D. T. Gwynne-Vaughan; lecturer in organic chemistry, Dr. A. W. Stewart; lecturer in physics, Dr. Robert Jack; lecturer in bio-chemistry, Dr. J. A. Milroy; lecturer in geology and geography, Dr. A. R. Dwerryhouse; lecturer on hygiene, Dr. W. James Wilson.

DR. G. S. WEST has been appointed to the chair of botany and vegetable physiology in the University of Birmingham, rendered vacant by the retirement of Professor Hillhouse.

DISCUSSION AND CORRESPONDENCE

REMARKS ON RECENT CONTRIBUTIONS TO COSMOGONY

TO THE EDITOR OF SCIENCE: In your issue of May 28 is a letter by T. J. J. See, ostensibly demanding "fair play and toleration" in the consideration of current contributions to science, but clearly written for the purpose of exploiting some of his own recent writings. In this letter, notwithstanding the implications of its caption, he takes occasion to characterize the work of Professor Chamberlin and myself as "inconsistent and purely destructive," and says:

> If Professor Blackwelder will study my last paper carefully, and the work now in press, when it appears, he will find that most of the recent speculations on cosmogony are not worth the paper they are written on; and yet some of them have been published by the *Astrophysical Journal* and the Carnegie Institution.

He also modestly states:

> It is only fair to say that no constructive results of consistent character had been reached on this subject till my own investigation was completed last year. . . . As I have worked on this subject uninterruptedly for twenty-five years, I am prepared to speak with some degree of authority.

Because of these extravagant pretensions and the fact that a majority of the readers of SCIENCE, being unfamiliar with the details of recent developments in this subject, will not credit any one with having the monumental nerve to put forward such claims without there being some basis for them, I beg the privilege of taking enough space to state briefly the facts relating to this matter.

The well-known nebular hypothesis was put forward briefly by Laplace, in 1796, at the end of a work on popular astronomy. Its simplicity and attractiveness, as well as the great name of its author, soon gained for it wide acceptance among scientific men. It satisfied those racial instincts for an explanation of the origin of things which gave rise to the cosmogonies of the ancients; and in stirring the emotions, the majestic sweep of events which

it described took the place of the heroic deeds celebrated in their epics. But its greatest value was in making, in the first half of the nineteenth century, a foundation for the development of geological theories respecting the age and evolution of the earth, and these theories, in turn, were important factors in Darwin's elaboration of his "Origin of Species."

The next important step in cosmogony was Helmholtz's contraction theory of the heat of the sun, published in 1854, which not only was not contradictory to the Laplacian theory, but was generally supposed to be a proof of its correctness.

In the latter half of the nineteenth century the Laplacian theory was supplemented by the consideration of some factors originally omitted, chiefly by Roche and Sir George Darwin, and some objections were urged against it, chiefly by Babinet and Faye. But the writings of practically all astronomers show that it was generally accepted without fundamental modifications. For example, Sir George Darwin in his classical researches on tidal evolution frankly stated that he accepted it in its main outlines; and in 1886 C. Wolf, of the Paris Observatory, reprinted in book form a series of articles appearing earlier in *Bulletin Astronomique,* Vols. I. and II., which clearly supported this theory. In the preface to this volume we read:

> Mon principal but, en écrivant ces articles, était de montrer que la théorie de Laplace répond encore aujourd'hui le mieux possible aux conditions que l'on est en droit d'exiger d'une hypothèse cosmogonique.

In the late nineties Professor Chamberlin in studying the earth's atmosphere, and particularly its origin and history, became skeptical of the soundness of the Laplacian theory; and simultaneously some of its weaknesses were forced on me while considering it in my classes in descriptive astronomy. Toward the end of 1899 we had several conferences on the question of its correctness, and as a result of these discussions we decided to test it, first as to its agreement with the facts established by observations, and secondly as to its self-consistency. The results of these inquiries are contained in a paper published by Professor Chamberlin in the *Journal of Geology,* February–March, 1900, and in one by myself in the *Astrophysical Journal,* March, 1900. It is well known that the conclusions reached in these papers seemed to us so adverse to the theory as to compel us to reject it as being no longer a satisfactory hypothesis; and since that time many astronomers have placed themselves on record as being in agreement with us.

Immediately after the publication of these papers constructive work was begun, chiefly by Professor Chamberlin. The first account of the new hypothesis which was developed was published by Professor Chamberlin in Year Book No. 3 of the Carnegie Institution, pp. 208–253 (1904), and another was published by myself in the *Astrophysical Journal,* Vol. 22, pp. 165–181 (1905). In Chamberlin and Salisbury's "Geology," Vol. 2, pp. 38–81 (1906), under the title of The Planetesimal Hypothesis, Professor Chamberlin gives an extensive account of the proposed theory. Some of the subheadings are: Subvarieties of the Hypothesis, The Hypothetical Origin of the Solar Nebula, The Contingencies of Stellar Collision, The Contingencies of Close Approach, The Special Consequences of Close Approach, The Acquisition of Rotatory Motion, The Result a Spiral Nebula, The Assigned Nebular Origin not Vital, The Evolution of the Nebula into Planets, The Part Played by Ellipticity of Orbit, The Evolution of Circularity, The Time Involved, The Bearing of the Mode of Accretion on the Direction of Planetary Rotation, The Spacing-out of the Planets, . . . He closes the chapter with the following summary:

> The planetesimal hypothesis thus assumes that the solar system was derived from a nebula of the most common type, the spiral, and that the matter of this parent nebula was in a finely divided solid or liquid state before aggregation, in harmony with the continuous spectra of spiral nebulæ. It regards the knots of the nebula as the nuclei of the future planets, and the nebulous

haze as matter to be added to the nuclei to form the planets. It assumes that both the knots and particles of the nebulous haze moved about the central mass in elliptical orbits of considerable, but not excessive, eccentricity. It postulates a simple mode of origin of the nebula connected with the not improbable event of a close approach of the ancestral sun to another large body, but the main hypothesis is not dependent on this postulate.

It assigns the gathering-in of the planetesimals to the crossing of the elliptical orbits in the course of their inevitable shiftings. Out of this process and its antecedents, it develops consistent views of the requisite distribution of mass and momentum, of the spacing-out of the planets, of their directions of rotation, of their variations of mass, of their varying densities, and of other peculiarities.

It deduces a relatively slow growth of the earth, with a rising internal temperature developed in the central parts and creeping outward. With such a mode of growth, the stages of the earth's early history necessarily depart widely from those postulated by the Laplacian and the meteoritic hypotheses. These stages now claim our attention.

In my "Introduction to Astronomy," pp. 463–487 (1906), I have discussed the same theory under the title of The Spiral Nebula Hypothesis. Some of the headings of the articles in this section are: Hypotheses Respecting the Antecedents of our Present System, A Possible Origin of Spiral Nebulas, The Development of the Solar System from a Spiral Nebula, The Origin of Planets, The Origin of Satellites, The Planes of the Planetary Orbits, Rotation and Equatorial Acceleration of the Sun, The Small Eccentricities of the Planetary Orbits, The Rotations of the Planets, The Eccentricities of the Satellite Orbits, The Moment of Momentum of the System, The Evolution of the Planets, The Age of the Solar System, The Future of the System. . . . The chapter is closed with the following summary:

> The first word should be one of warning that the theory which has been sketched briefly should not be accepted as final. There are many points where quantitative results must be obtained and compared with our actual system. There may be many modifications of it possible and necessary. For example, the genesis of spiral nebulas may be different from that postulated above.
>
> The hypothesis of an original spiral nebula is suggested by recent photographs of nebulas as well as by the system itself. The conditions which are supposed to have given rise to the spiral nebula seem most reasonable in view of the motions of the stars. The development of a spiral nebula by the near approach of two suns seems to be a necessary consequence, though this point needs further elaboration. The development of some such a system as ours from a small spiral nebula of the type considered seems to be inevitable. So far as the details have been worked out nothing directly contradictory to the theory, or even seriously questioning it, has been found, while it explains admirably all the main features of the system. It can be safely said that, at present, this hypothesis satisfies all the requirements of a successful theory much better than any previous one.

Since the publication of these books the work of elaborating and testing the theory has been carried forward by both Professor Chamberlin and myself, and a part of the results obtained have been published by the Carnegie Institution.

The alleged twenty-five years of uninterrupted work upon the evolution of the solar system by See have resulted only in the following papers so far as I am aware: (1) "Significance of the Spiral Nebulæ," *Popular Astronomy,* pp. 614–616 (December, 1906); (2) "On the Cause of the Remarkable Circularity of the Orbits of the Planets and Satellites and on the Origin of the Planetary System," *Astronomische Nachrichten,* No. 4308 (February 24, 1909), the same paper printed in *Popular Astronomy,* May, 1909, and at least the substance of the same paper communicated by its author to the Chicago *Record-Herald* early in 1909.

In the paper in *Popular Astronomy,* written over the date October 23, 1906, See makes the following statements:

> For a number of years the writer has given consideration to the probable nature of the spiral nebulæ, and their importance has been considerably increased by photographs obtained by Roberts and Keeler, and more recently at the Yerkes Observatory. Certain speculations have been in-

dulged in which implied that the spiral nebulæ are true nebulæ condensing into systems of stars. Though this premature and unauthorized line of thought has been extensively exploited, and even given place in one treatise on geology, it has always seemed to the writer quite unsound. I have consistently held that so far we do not know the true character of the spiral nebulæ, and this position is amply justified by the penetrating remarks of M. Poincaré. Whether the spiral nebulæ are other Milky Ways, as suggested by the illustrious French geometer, time alone can tell; and it may be several centuries before this question can be satisfactorily settled. Meanwhile the exploitation of the spiral form as typical of nebular development is certainly misleading, for, as Poincaré points out, there is no proof that these spirals are true gaseous nebulæ.

The speculations on spiral nebulæ have been decidedly overdone, and it is time to call a halt. There is not the slightest probability that our solar system was ever a part of a spiral nebula, and such a suggestion is simply misleading and mischievous. The great circularity of the planetary orbits shows the absurdity of such an hypothesis. . . . Least of all can we expect any light from the much exploited spiral nebulæ, which as M. Poincaré justly remarks, may be other galaxies. It is time, therefore, to drop such spirals from our text-books, or to candidly admit that we are quite in the dark as to their true significance.

In the last paper of See recently published in the *Astronomische Nachrichten* and several other places we read:

The solar system was formed from a spiral nebula, revolving and slowly coiling up under mechanical conditions which were essentially free from hydrostatic pressure. And spiral nebulæ themselves arise from the meeting of two or more streams of cosmical dust. The whole system of particles has a sensible moment of momentum about some axis, and thus it begins to whirl about a central point, and gives rise to a vortex. In the actual universe the spiral nebulæ are to be counted by the million, and it is evident that they all arise from the automatic winding up of streams of cosmical dust, under the attraction of their mutual gravitation. . . . When the nebula rotates and the coils wind up in such a way as to leave open spaces between the coils, or at least freedom from sensible hydrostatic pressure, the usual result is the development of a system made up of small bodies, such as the planets compared to the greatly preponderant sun, or the satellites compared to the much greater planetary masses which control their motions. In the solar system where the conditions are accurately known this is proved to have occurred; and it was repeated so many times always with uniform results giving a large central mass and small attendant bodies that the general law for this condition is clearly established.

Thus we see the variety of "consistent" conclusions recently reached by the twenty-five years of uninterrupted work on this subject.

At the end of this paper See admits its value in the following modest terms:

It has seemed advisable to call attention to the cause of the roundness of the orbits of the planets and satellites, because it appears likely that the criteria now introduced may go far towards clearing up the mystery which has always surrounded the origin of our solar system.

In See's paper there are only two points of divergence from the ideas fully developed by Professor Chamberlin and myself. The first is that spiral nebulas have their origin in "the meeting of two or more streams of cosmical dust." The second is that satellites are captured bodies. This latter view has been advanced by many amateurs and a few astronomers. It was considered in my writings quoted above, and rejected for what seemed to me to be good reasons. The resisting medium on which so much stress is laid is simply a special case of the collisions of *any* character considered by Professor Chamberlin and myself.

The quotations above are sufficient to remove the clouds which See's pretensions of long study of, and valuable contributions to, this subject might raise in the minds of those not particularly familiar with the history of recent developments in cosmogony. I wish to point out that notwithstanding the evidence furnished by his 1906 paper of his familiarity with our work, and in spite of the fact that at his request I furnished him reprints of my papers several months in advance of his recent publication, there is in it no direct or indirect reference to Professor

Chamberlin or myself. Ordinarily such conduct justifies the use of strong terms in characterizing it, but in the present case I believe astronomers and others who are familiar with the situation will fully agree with me that these aberrations are more deserving of pity than of censure. F. R. MOULTON

June 10, 1909

COMMUNICATING WITH MARS

TO THE EDITOR OF SCIENCE: In view of the recent proposals for opening communication with the planet Mars, as reproduced by the European press from American newspapers (with accompanying portraits), no truly patriotic American can fail to feel a thrill of pride and exultation at the thought that it his country that is solving this great cosmic problem. It is time to sound the alarm, however, for there are indications that an attempt will be made to rob us of the honor after all. A distinguished French astronomer has recently published a letter on the subject, in which, while giving a small measure of approval to the American projects, he broadly intimates that the last word has not been said. The Germans are keeping very quiet, but it is rumored that Count Zeppelin is thinking, and in commercial and manufacturing circles there is great though silent activity in the direction of trying to ascertain in advance just what articles now "made in Germany" are likely to be most in demand among the inhabitants of Mars when once communication is opened. Assuming that the planet is correctly named (and it has borne the name for hundreds of years without protest), the great Krupp establishment is looking for a practical monopoly of trade, and to meet the expected emergency it has taken options on all the land adjacent to the present planet. Their engineers are known to entertain the opinion that it will be a comparatively simple matter to send to Mars a 14-inch 70 foot gun, first, of course, hermetically sealing it in the aluminum cylinder. If it should not reach the exact spot where it is wanted it can readily be transported anywhere by canal boat.

Having all this information, which has only recently come to me, I have decided to protect American interests by making premature publication of my own scheme for signaling to our celestial neighbor, which, for efficiency, simplicity of arrangement and ease of operation altogether surpasses, I think, all will admit, anything hitherto before the public. It is well known, even among astronomers, that as the orbit of the earth lies between the sun and that of the planet Mars, the dark side of the earth must, at regular intervals and for considerable periods of time, be turned toward Mars.

A hole through the earth would, at this time, allow the passage of a beam of sunlight, the intelligent interruption of which could be made to appear as a series of signals, using the Morse (E. S.) code or any other that might be chosen.

That is all; the problem is solved in this simple way.

One can readily understand how the system might be also put in operation on the moon, if the lunatics would only bore a hole through which the sun might shine when the dark side of the moon was toward us and then arrange a device for cutting off this beam of light at will. For our immediate purpose of wigwagging to Mars such a hole must necessarily be several miles in diameter. Although some minor difficulties in the way of the execution of this plan remain to be overcome, many of the details are already settled, including the selection of the spot where such an opening might best be made in the interests of mankind generally. T. C. M.

DRESDEN, GERMANY,

May, 1909

P. S. I regret that I have no portrait to send with this.

"TYPHOID MARY"

MUCH has appeared in the press of late concerning the unfortunate woman who for two years past has been held a prisoner upon North Brothers Island by order of the board of health. On June 29 she appeared before Supreme Court Justice Giegerich on a writ of habeas corpus, sued out by her attorney to obtain her release. Judging from the evidence,

we all know that Mary is a "typhoid carrier," and a dangerous one by reason of her occupation as a cook; but she is only one among many such "carriers" and it is scarcely justice to place upon her alone the burden that should be shared by her entire class.

Of all those who recover from typhoid fever something like four per cent. carry about with them the germs of the disease for long periods of time. They are "carriers" in fact, and can, like Mary, become centers for secondary infection. There are at the present moment probably 560 such persons in the state of New York, representing four per cent. of the 14,000 cases of typhoid fever occurring during the past year. How many must be added to that number to allow for the "hold-overs" coming down from previous years it would be hard to guess. Others will be added during the year to come.

We can not keep in detention all these people, then why single out and imprison one.

Typhoid carriers are dangerous when they are possessed of uncleanly personal habits, and they become more so when their occupations have to do with the preparation of food.

It would be eminently wise to instruct a "carrier" as to the danger lurking in human dejecta and to insist upon the necessity for great personal cleanliness. It might be also well for the authorities to direct that such a person should not be engaged in the preparation of food; but beyond "education" and an order for "change of occupation" it is scarcely practical or fair to go.

W. P. Mason
Rensselaer Polytechnic Institute,
July 1, 1909

QUOTATIONS

Mr. Latham's Aeroplane

After a comparatively short training, Mr. Hubert Latham has brought the Antoinette monoplane from obscurity into serious rivalry with the Wright machine as regards duration of flight, while it is easily superior in speed. He has also shown that it can be flown in windy weather, and the ease with which he controls it quite upsets the theory held by the bi-planists that the monoplane is exceedingly difficult to manage. Nevertheless, when the experience of Mr. Latham is placed alongside that of the many other monoplanists, who so far have not been particularly successful, the point is demonstrated that the human element counts for much. It would appear that Mr. Latham is something of a genius in navigating aerial machines.

The Antoinette monoplane, which is designed by M. Levavasseur, consists of a central skiff-like body, from each side of which a main plane springs at a slight upward tilt. The single propeller is mounted in front of the central body, and close behind is the motor. In a well to the rear of this the pilot is comfortably situated, his position allowing him a clear look-out, and affording a certain degree of protection not noticeable in other machines. Indeed, Mr. Latham claims that he is very safe from injury in this machine, being well protected by the planes and the body of the vessel.

At the rear of the main body are vertical equalizing fins, two vertical rudders, and a horizontal elevator for giving upward or downward direction. The lines of the body are very clean, the total bearing surface is remarkably small, and there is an absence of the many stays and members which, in the biplane especially, lead to increased head resistance and consequent loss of speed. At the rear end of each main plane is a flexible extension, which can be given a varying angle of incidence for purposes of stability.

The under-frame is a clever piece of work. The chassis rests on two wheels placed close together, and a forward extension of this frame takes the form of a runner, which is designed to receive the first shock of landing and thus save the wheels from buckling strains. The combination of sledge runner and wheels in the Antoinette enables the aeroplane to be started without the use of extraneous mechanism, whilst it allows landing to be effected at speeds which would smash any ordinary wheel.

The control of the Antoinette machine is by means of side wheels, those at one side

governing the warping planes, and at the other controlling the elevator. There is another controlling agent for the side rudders, and yet another for the fuel supply to the engine. The controlling mechanism is grouped in such a manner as to afford easy mastery over them, and Mr. Latham has shown that he can travel in the air without both hands being busily occupied.

The eight cylinders of the engine are grouped in two banks of four, arranged in V fashion; petrol is injected direct on to the inlet valves, no carburetter being employed. The fuel supply is governed by a pump of variable throw, and the necessary air is supplied through air pipes leading to the valves. The water-cooling arrangement on the Antoinette engine is also unique. Very little water is employed, and it is quickly turned into steam. This is carried away to an effective condenser, the tubes of which line the side of the main body. The condensed water is taken by a pump to the water tank, and thence is pumped to the cylinder jackets. This engine gives one horse power for about every three pounds of weight.—The London *Times*.

SCIENTIFIC BOOKS

Revision of the Mice of the American Genus Peromyscus. By WILFRED H. OSGOOD, Assistant, Biological Survey. Prepared under the direction of C. HART MERRIAM, Chief of Biological Survey, Department of Agriculture. North American Fauna, No. 28. Washington, Government Printing Office. April 17, 1909. Pp. 1–280, text-figs. 1–12, pl. I.–VIII.

Mammalogists have awaited with eagerness the long-delayed publication of Mr. Osgood's monograph of the genus *Peromyscus*. The work consists of a systematic study of all the members of the genus, and includes keys for the identification of the various forms, together with the necessary illustrations, and maps showing the geographical distribution of the species.

Plate I. (colored) illustrates the distribution of the species and subspecies of the *Peromyscus maniculatus* group, plates II. to VIII. depicting the cranial and dental characters of prominent species of the genus, and text-figures 1 to 12 portraying the geographical distribution of the various species and groups.

As stated by the author:

> The American genus *Peromyscus*, including the so-called wood mice, deer mice, vesper mice or white-footed mice, has needed revision for many years. One or more of its numerous species and subspecies inhabit almost every part of North America; moreover, these mice, wherever found, are among the most abundant of small mammals. The group, therefore, is of such importance that it must be dealt with in every work on North American mammals, whether pertaining to classification, geographic distribution or economic relations.

It is now about seven years since Mr. Osgood undertook the revision of this great genus of American murines, which has just been brought to a most satisfactory conclusion. During this time, in spite of many interruptions, he has examined all of the specimens of the genus *Peromyscus* in the great museums of America and in numerous private collections, in the British Museum, and the museums of Europe, having unearthed *Peromyscus* types in the museums of Munich and Zurich.

In 1891, Dr. J. A. Allen, after discussing certain species of *Peromyscus*, made the following statement:

> But the time has not yet come for a satisfactory revision of the group, to attempt which at least 20,000 specimens are requisite, collected so as to fully represent the seasonal phases of pelage obtaining at hundreds of more or less widely separated localities.

Mr. Osgood remarks:

> These conditions are now realized to the fullest degree, for the number of specimens examined in the present revision exceeds 27,000. The majority of these are contained in the extensive collection of the Biological Survey, which, under the direction of Dr. C. Hart Merriam, has been built up with special reference to the various life areas of North America, and without which no satisfactory study of this group would now be possible. . . . This material includes all the types, both of valid forms and of synonyms, known to be in existence.

In almost all cases in which no types exist, good series of topotypes, or specimens from near the type localities, have been available.

Mr. Osgood's study of this wealth of material has resulted in a definite expression of the characters of the species and geographic forms of *Peromyscus,* almost the last important genus of North American mammals which has remained to be systematized by a trained mammalogist in possession of an abundance of well-prepared and carefully-selected specimens.

The chaotic condition of *Peromyscus* can best be illustrated by a quotation from the author's introduction, under the caption of "History and Nomenclature":

> In fact, no fewer than 167 names for new or supposed new forms of *Peromyscus* have been proposed since 1885. Add to this the 14 contained in the present paper, and the total of 181 is reached. . . . Of the 167 names [excluding those proposed by the author in the present monograph] for supposed new forms of *Peromyscus* proposed since 1885, 58, practically one third, are of more than doubtful status and are here treated as synonyms.

The subject matter is presented under the following headings: Introduction, Material, History and Nomenclature, Variation, Intergradation, Pelages, Color Descriptions, Measurements, Keys, Records of Specimens, Subgenera, Habits and Economic Status, List of Species and Subspecies with Type Localities, New Subspecies, Genus *Peromyscus,* Subgenus *Peromyscus,* Subgenus *Megadontomys,* Subgenus *Ochrotomys,* Subgenus *Podomys,* Subgenus *Haplomylomys,* Subgenus *Baiomys* and Table of Measurements.

The paper, throughout, has the advantage of being written in simple language adapted to the use of ordinary workers, to whom hints of practical value are being continually thrown out, the author happily having adopted the principle of helping rather than impressing his readers. There is also a pleasing element of fairness, and impartial weighing of evidence, when dealing with the writings of previous authors, which reflects the personality of the author.

The folded map (Plate I.) showing, in colors, the distribution and intergradation of the 39 subspecies of *Peromyscus maniculatus* must excite the astonishment and delight of mammalogists, inasmuch as showing that, at last, we have acquired enough specimens of one large and complex group to illustrate its interrelations. Many of the named forms which Mr. Osgood has placed in synonymy represent the wavy lines, which, in his colored diagram, show "areas of intergradation." Who, years ago, could have imagined that *Peromyscus canadensis* Miller (= *Peromyscus maniculatus gracilis*) and *Peromyscus pallidus* Allen could possibly be proved to be conspecific forms, actually intergrading through the subspecies *maniculatus, arcticus, nebrascensis, luteus* and *bairdi?* Again, in 1890, the reviewer described *arcticus* as a subspecies of *leucopus,* and, the same year, Merriam ventured to separate *rufinus* from *leucopus* as a subspecies. Now we know that these forms are distinct from the species *leucopus* and belong to the then unrecognized species *maniculatus.* This knowledge is due to the possession of adequate and carefully-studied material.

An important feature of Mr. Osgood's monograph is the wonderful key to *Peromyscus,* which is one of the best of its kind. With it, one can open the *Peromyscus* cage with the certainty that the particular white-stockinged little mouse wanted will prance out at the simple turn of the wrist. One can not fail to admire the ingenious construction of this key that actually works the combination.

As a reviewer, I suppose I ought, in self-defense, to find some fault with a monographer who has had the temerity to relegate several forms described by myself to the category of synonyms; but I have not the disposition to find fault with a work of such practical utility and completeness, planned on uniform lines, and carried out to such a satisfactory conclusion. It is really straining a point when, for instance, I assert that, in my opinion, *Peromyscus eremicus arenicola* should have been recognized as a valid subspecies of the Eastern

Desert Tract; and when I expostulate at having my *Peromyscus boylii penicillatus* compared with "a series from the Franklin Mountains near the type locality [of *penicillatus*]," which mountains lie wholly without the eastern desert differentiation tract, as defined in my mammals of the Mexican boundary line; also, *Peromyscus boylii pinalis* is, in my estimation, the Transition, zonal form of *P. b. rowleyi* of the Upper Sonoran Zone; but, on the whole, I am convinced that mammalogists will regard Mr. Osgood's conservatism, in the matter of recognizing subspecies, with favor. I am still of the opinion that Dr. True's subgenus *Baiomys* should be raised to the rank of a genus.

In conclusion, I take off my hat, and make a low bow to Mr. Osgood, as the author of one of the best papers dealing with North American mammals.

EDGAR A. MEARNS

The General Character of the Proteins. By S. B. SCHRYVER, Ph.D., D.Sc., Lecturer on Physiological Chemistry, University College, London. London, New York, Bombay and Calcutta, Longmans, Green and Co. 1909. Pp. x + 86.

A review of progress in any field of study can serve a diversity of purposes. As a summary of discoveries made it brings an up-to-date appreciation of current knowledge and makes it ready for convenient reference; and if the résumé has been critically prepared, it may fulfill the almost equally important function of pointing out the limitations of our experience in any domain and the problems awaiting solution. In the latter respect especially, Dr. Schryver's monograph deserves commendation. The author has taken pains to emphasize how inadequate are the more familiar characterizations of the proteins and how imperfect the criteria of purity, individuality, etc., which are currently applied.

To those less familiar with the extensive literature on this subject it may come as a surprise to learn that the time-honored methods of isolation and identification of proteins employed in every biochemical laboratory are at best extremely defective and unreliable. The investigator will find the refreshing suggestion that the contributions of modern colloid chemistry are far from adequate for an elucidation of the properties of the proteins; so that for some time to come, at any rate, "reliance will have to be placed chiefly on the purely chemical methods for the identification of the proteins."

The monograph is grouped into a review of: (1) The physical properties of the proteins, (2) their general chemical characters, and (3) a very brief reference to the biological methods of identifying proteins. It thus supplements Professor Aders Plimmer's earlier review of the chemical constitution of these compounds.

Among the diverse topics under discussion, that of the behavior of proteins towards acids and bases and the question of salt formation by them has, very properly, received a proportionately large share of attention from the author. This is most timely; for a more profound explanation of these phenomena will go far, we are confident, to explain many peculiarities of protein behavior. The limitation of cryoscopic methods applied to proteins in the present state of our knowledge of colloids is pointed out. The hope is expressed that some elaboration of quantitative reactions may be effected, so that the proteins may be characterized thereby. This is approached most nearly in the constants for the distribution of nitrogen in the molecule ("Hausmann numbers"). It is not unlikely that a tyrosine factor (Millar), or an amino-index (Brown, Sörensen) may give us useful data comparable, as Dr. Schryver suggests, with the constants employed in fat analysis.

In the discussion of the "salting out" of proteins the early work of Dénis is given a recognition which most writers overlook. The expression "prosthetic group" usually ascribed to Kossel is attributed to Hoppe Seyler (pp. 3 and 32). In the discussion of methods of crystallizing egg albumin, the experience of T. B. Osborne[1] and other investigators is overlooked. A similar comment

[1] *Jour. Amer. Chem. Soc.*, 1899, XXI.

might be made on the chapter concerning sulfur in proteins (p. 36).[2] The author's surmise (p. 32) that the Millon's reaction given by gelatin may be due to an impurity is scarcely justified since the work of Pickering, Van Name and Mörner.

The appended bibliography is useful, although by no means complete.

Lafayette B. Mendel
Sheffield Scientific School
of Yale University,
New Haven, Conn.

SPECIAL ARTICLES

NOTES ON SOME SALAMANDERS AND LIZARDS OF NORTH GEORGIA

The following salamanders and lizards were observed at Thompson's Mills, Gwinnett County, north Georgia, during the summer of 1908.

Among the batrachians of the order Urodela, the following salamanders were found.

Plethodon glutinosus (Green). This is a thick, stout-bodied, nearly cylindrical species, and is capable of secreting a viscid, milky juice, which has given it the name of the sticky salamander. Specimens found at Thompson's Mills, Ga., in life, were dark bluish slate above, lighter or paler on the belly. The back and head were thinly sprinkled with tiny, grayish-white dots, with a few whitish or grayish dots beneath, mainly on the throat. The sides were mottled with grayish, forming an almost continuous band to the end of the tail. Length 5¼ inches. Several specimens of this salamander were found at the above locality, all beneath logs and the bark of decayed, fallen trees, in shady, damp woods. This salamander is terrestrial in its habits, and occurs in the extreme north as well as throughout the south. It is not uncommon at Thompson's Mills, Ga.

The red salamander (*Spelerpes ruber* Daudin). At maturity this is a thick, plump, short-bodied species, with small, weak legs. Its skin is clear, smooth, without glands, but besprinkled with shallow pits.

The specimens found at Thompson's Mills were 4¼ to 5 inches long. In living specimens the coloration above was brick-red, very much paler (or pinkish) on the belly. The back and head were thickly and uniformly sprinkled with black dots about the size of pinheads. Along the sides these dots became much smaller and more scattered, and were completely wanting along a line drawn along the sides connecting the outer attachment of the legs. The legs were of the same color as the back, and finely dotted with black.

This pretty salamander also ranges over the eastern portion of the country. At Thompson's Mills, I found only two individuals, both beneath rotten logs in hilly woods. This species is of more aquatic habits, which probably accounts for the fact that an examination of hundreds of rotten stumps and logs in the upland woods yielded only two specimens.

Spelerpes gutto-lineatus (Holbrook). This is a very pretty, slender and elongated animal, with a slender, compressed tail, longer than the body. Living individuals which I have found at Thompson's Mills showed the coloration described as follows. Beginning just back of a line joining the eyes, a narrow, black stripe extended along the back bone, to a point just behind the legs where it terminated abruptly. Bordering this stripe on either side, is a light grayish-brown stripe beginning at the tip of the nose and extending just above the eyes. These light, dorsal stripes unite on the tail where the black, spinal stripe terminates. On each side beginning from the eye, another narrow, black stripe extended to the tip of the tail, narrowing in proportion as the tail becomes more attenuated. This lateral black stripe was spotted with whitish marks, and its lower edge outlined with white. The belly was evenly and thickly mottled with yellowish and light gray. I found only two specimens of this salamander at Thompson's Mills, both under a log in wet ground near a brook. Their lengths were 7 inches and 5¾ inches, respectively. This salamander is mostly southern in its range.

[2] Cf. *Jour. Amer. Chem. Soc.*, 1902, XXIV., 140.

Desmognathus fusca. This small, aquatic salamander occurs in the brooks at Thompson's Mills. In its coloration, this species shows great variability. In March of the season 1908, I found some small individuals in a brook at the above locality.

Among the lacertilia, the following lizards were found at Thompson's Mills.

The blue-tailed skink (*Eumeces fasciatus* Linnæus) is exceedingly common at the above locality and elsewhere in the south. In every field and wood, they may be found basking in the sun or running with great rapidity over the ground, until they seem only a streak, hence the common name streak-field. I have very frequently captured this skink under the bark of fallen trees, and in decayed stumps. As the sun goes down, these creatures seek shelter in stumps and logs, and stone-heaps, etc., where they may be readily found. During the early part of the summer, at the egg-laying period, these pretty lizards were frequently to be found in hollow stumps and logs. Under date of June 13, 1908, I find a record in my field journal, of a male and a female skink together with seven eggs, in a cavity under the bark of a rotten log. The eggs were lying in a group on the decayed wood beneath the bark, and showed the following dimensions:

	Length. Cm.	Width. Mm.
1	1.35	8.5
2	1.25	9.5
3	1.35	9.0
4	1.20	9.0
5	1.30	8.5
6	1.25	8.0
7	1.30	9.0

These eggs were perfectly elliptical, with a white, tough membrane for a shell, and contained young lizards. I have frequently found this lizard in the crevices and hollows of dead trees a considerable distance from the ground. Captured, it tries very hard to escape, and will snap viciously at one's fingers, although it can do no injury. The coloration of this species is very brilliant, with a high luster. The older males are commonly known as scorpions, and are considered extremely poisonous.

Sceloporus undulatus (Latreille). This common lizard is familiar to nearly every one throughout the south. At Thompson's Mills, it is very abundant in all wooded upland situations, and loves to bask in the hot sun, stretched out lazily at full length on a fence-rail or rock. Disturbed, it runs with great agility, usually up the nearest tree. On the tree-trunk, it moves so that it keeps the tree between itself and the observer, as does a gray squirrel. Its coloration should be of very protective nature, as the dull-grayish and brownish markings very closely assimilate with the general grayish and brown colors of tree-trunks, lichen-covered rocks, etc. This gentle lizard when caught, makes little or no great effort to escape. I kept one for a considerable time on an upstairs porch of my dwelling at Thompson's Mills. Every day it came out from the vines and basked contentedly in the sun. This lizard feeds on all kinds of insects, including grubs, large grasshoppers, etc. I once witnessed one of these creatures attempting to capture a large grasshopper which had got among the grass and weeds in a thicket by the roadside. The grasshopper—one of the very large species—could not readily fly away on account of the grass and weeds, but dashed about, with the lizard following every movement, and in hot pursuit. To an observer witnessing this active chase, it would appear that this lizard must be able to see pretty well, although Dr. Abbott concluded that the vision of this lizard is not very acute. At another time, in the vicinity of Thompson's Mills, I came across one of these lizards, which scurried up a tree on my appearance. Something large and white was protruding from its mouth, causing the lizard to breathe in long, painful gasps. I killed the creature and found an enormous, hairy grub half swallowed head first. The grub was too large for the lizard to swallow, and could not be ejected, so that its mouth was forced wide open, and breathing rendered extremely difficult. At other times I have frequently watched these lizards snapping up very rapidly the tiny insects it met with on trees and logs.

Most of the specimens obtained were kindly identified for me by Dr. Stejneger, of the U. S. National Museum.

H. A. Allard

Bureau of Plant Industry,
Washington, D. C.

SOCIETIES AND ACADEMIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

The 220th meeting of the society was held at the Cosmos Club on Wednesday evening, May 12.

Regular Program

Significant Time-breaks in Coal Deposition: Mr. Geo. H. Ashley.

In a study of the results which were recently published in *Economic Geology*, it was found that one foot of bituminous coal, if deposited under present-day conditions, would require at least three hundred years for its laying down.

Considering the known variation in the thickness of single coal beds, the question arises as to whether it may not prove possible to use a coal bed as a measuring rod for the time of deposition of other beds in the coal measures. Thus, in the case of a bed 15 feet thick in one district and 18 inches in another, if the coal in each case were deposited at the same rate, the 15-foot bed required *at least* four thousand years longer than the 18-inch bed. Study was made to see if where the coal was thin there was a compensating thickening of the adjoining rocks. As far as the study was carried no such compensating thickening could be found. It was therefore assumed that in the cases examined the thin bed of coal represents approximately all of the deposit made at that point during the time required for the deposition of the thick bed near by. This resulted from either slow growth or time-breaks either in or just preceding or following the thin coal bed itself.

A study of the rate of deposition of certain peats in Europe leads to the conviction that in many cases the difference in thickness is due to difference in rate of deposition, while in other cases the difference would seem to be due to time-breaks or periods of non-deposition.

The evidence of these time-breaks may consist of "smooth partings," which, as in the Lower Block coal of Indiana, may locally show as unconformities between the under- and overlying beds, or of smooth partings which are represented in other districts by up to 40 feet of shale and sandstone, as in Coal IV. of Indiana. In other cases one or two inches of cannel coal or bone may be represented in an adjoining district by a thick parting, as in the Moshannon bed, west of Houtzdale. In some beds partings of clay, shale or sandstone, where they are known, are uniformly thin and regular. In other beds they will vary from one fourth inch up to 40 or 50 feet. In such cases the great thickness of the parting often suggests, even though it does not prove, a considerable time interval.

A study of the problem seems to indicate clearly that the elements of slow growth and of temporary non-deposition can not be eliminated from it, and that it would be scarcely right to say that the rocks forming a parting in the coal, or that a certain thickness of rocks above or below the coal, may have taken a certain number of years for their deposition, equivalent to the time represented by the difference in the thickness of the coal at that point and at the point of greatest thickness, multiplied by an assumed rate of deposition of the coal.

Cretaceous Geology of the Carolinas and Georgia: L. W. Stephenson.

The belt of Cretaceous deposits which, with certain interruptions, extends along the inner margin of the coastal plain from Marthas Vineyard, Mass., to Cairo, Ill., has its widest areal development in the region of southeastern North Carolina and northeastern South Carolina.

In North Carolina three Cretaceous divisions are recognized. The oldest of these is of lower Cretaceous age, and consists of about 275 feet of light-colored, coarse, generally compact or partially indurated, feldspathic, cross-bedded sands with inter-stratified lenses of massive more or less sandy clays. So far as known these materials are non-fossiliferous. The beds are separated from the overlying Cretaceous strata by an unconformity. Employing physical criteria, the division has been correlated approximately with the Patuxent formation of Virginia and Maryland. The name Cape Fear formation was proposed for this terrane by the writer in a paper entitled "Some Facts Relating to the Mesozoic Deposits of the Coastal Plain of North Carolina," which appeared in 1907.

The next younger division, which is of upper Cretaceous age, consists of 500 to 600 feet of dark to black lignitic, irregularly bedded and for the most part laminated, sands and clays, with interbedded marine lenses in the upper portion. As regards their structural relations the beds rest

unconformably upon the Cape Fear formation and are overlain conformably by strata of the next younger Cretaceous division and by non-conformable post-Cretaceous deposits. Fossil plants occur from the base to the top of the division, and towards the top invertebrates occur in marine lenses interbedded with the plant-bearing beds. Both the physical and paleontologic characters point to the approximate equivalency of the formation with the Magothy-Matawan series of New Jersey and with the combined plant-bearing Tuscaloosa beds, the Eutaw formation and the lower portion of the Ripley formation of Alabama. As regards more distant correlations the plants seem to indicate equivalency with the Woodbine division of Texas, the Dakota formation of the western interior, and the upper Cenomanian or Turonian of Europe, while the invertebrates, which show a close faunal relationship with the overlying younger division in North Carolina, point perhaps even more strongly to equivalency with the Taylor-Navarro series of Texas and the Montana series in the western interior, both of which occupy positions not only above the Woodbine and Dakota formations, respectively, but also above the still higher Colorado group representatives. There exists, therefore, a difference of opinion which with the present array of facts is irreconcilable; and the question of the correlation of the division with deposits outside of the Atlantic coast and eastern gulf regions must remain an open one until additional data are procured. In the paper previously mentioned the writer proposed the name Bladen formation to designate these beds.

The third and youngest division, also of upper Cretaceous age, consists of 700 to 900 feet of dark gray, more or less argillaceous and calcareous, marine sands and clays, conformably overlying the Bladen formation, and unconformably overlain by Tertiary and later deposits. The beds carry marine invertebrates indicating approximate equivalency with the Monmouth formation of New Jersey and with the upper Ripley beds of Alabama. Employing the same criteria, the division is correlated with the Navarro formation of Texas, the Montana series in the western interior, and the Senonian of Europe. The name Ripley formation was applied to this division by the writer in 1907, but owing to uncertainty which has arisen regarding the exact meaning of this term as employed in the gulf region it will probably have to be dropped, in which case the name Burches Ferry formation applied by Sloan to the southward continuation of the terrane can appropriately be employed in North Carolina.

In both South Carolina and Georgia equivalents of all three of the divisions occurring in North Carolina have been recognized, and their approximate areal distribution determined.

The Santa Maria Graphite Mines, Sonora, Mexico: FRANK L. HESS.

The Santa Maria graphite mines which are owned by the United States Graphite Company, of Saginaw, Mich., are situated about twenty miles south and a little east of La Colorado, in central Sonora. The country rock is a metamorphosed sandstone, ranging in fineness from shaley material to conglomerates containing pebbles one and one half inch in diameter. Considerable andalusite in small crystals is developed in the sandstones. The rocks are probably of upper Triassic (Richmond) age. They are intruded by graphite which has been the metamorphosing agent. Intercalated with the sandstones are at least seven beds of graphite ranging in thickness up to 24 feet and standing at high angles. The rocks are considerably folded and the graphite beds show the effect of movement more than the enclosing sandstones, so that they are in places almost cut off through squeezing, while in other places they show thickening. The graphite beds are also intruded by granite dikes and in places granite forms the walls. The graphite is undoubtedly formed through the metamorphism of coal beds, which in other parts of the state are to be found in the form of coke, anthracite and bituminous coal. The graphite of the Santa Maria deposits is entirely amorphous and from the main vein averages 85 to 86 per cent. graphitic carbon. Specimens may be picked which carry 95 per cent. graphitic carbon.

The material is shipped to Saginaw, Michigan, for refining. A large part of the best pencils are made from this graphite. It is also used for a lubricant, foundry facings, etc.

AT the 221st meeting of the society, held at the Cosmos Club on Wednesday evening, May 26, Mr. S. F. Emmons spoke informally on the Cobalt mining region.

Regular Program

Diopside and its Related Minerals: ARTHUR L. DAY.

The formation of pure wollastonite from its component oxides, lime and silica, and its combination with magnesium metasilicate to form diopside, together with a record of the character

and stability of all the mixtures which result when one of the components is present in excess of the exact proportion required to form the mineral, establishes the practicability and effectiveness of physico-chemical methods in solving such questions as the order of crystallization from the magma and the stability of the crystalline products formed during the cooling to present temperatures. The relations between these minerals are nearly all eutectic, and when considered in connection with previous work on isomorphous mixtures, serve to illustrate the certainty with which such measurements upon rock-making minerals can be made and interpreted, their freedom from dependence on the personal judgment of the observer, the comprehensive way in which characteristic differences of physical form, as well as those of chemical composition, are taken into account, and the ready adaptability of the system to provide a more comprehensive classification of the mineral relations whenever a sufficient body of such measured data shall have been gathered.

The scope of the laboratory problem, that is, the immense domain within which these methods have now been successfully applied, is shown by the fact that these minerals were studied not only through all percentages of the components, but over the entire range of temperatures in which stable forms occur, either in the mineral compounds or their components—in all, a range of about 2,100 centigrade degrees.

Pure silica was found to possess three stable crystal forms: (1) α-quartz—stable at ordinary temperatures and up to 575° C.; (2) β-quartz—stable from 575° to 800°; (3) tridymite (cristobalite)—stable from 800° to the melting temperature (1,600°).

Pure lime has but one form which melts in the electric arc but is out of reach of accurate pyrometry.

Lime and silica combine to form two compounds: (1) The metasilicate—which exists in two stable crystal forms: (*a*) Wollastonite, stable at ordinary temperatures and up to 1,190° C.; (*b*) pseudo-wollastonite, stable from 1,190° to its melting point, 1,512°. (2) The orthosilicate—with three stable crystal forms which were designated for convenience: α, stable from 1,410° to the melting temperature, 2,080°; β, stable from 675° to 1,410°; γ, stable at ordinary temperatures and up to 675°.

The metasilicate of lime combines with the metasilicate of magnesia—possessing two stable and three unstable crystal forms, of which one (unstable) corresponds to enstatite—to form only one mineral, diopside, stable at all temperatures up to its melting point, 1,395°.

The measurements were made at constant (atmospheric) pressure and in the absence of water.

The measurements themselves depend upon: (1) the chemical purity of the component minerals; (2) the ability to establish equilibrium between them at the temperatures where the characteristic changes occur within the time available for a laboratory experiment; (3) sufficiently sensitive and accurate temperature measuring devices to locate with certainty every characteristic change in the energy content of the system.

The Slumgullion Mud Flow: Mr. Whitman Cross.

The Slumgullion mud flow is a landslide of unusual character, which took place many years ago in an eastern tributary of the Lake Fork of Gunnison River a few miles above Lake City, Colo. The damming of the Lake Fork by this flow caused Lake San Cristobal, a sheet of water two miles long.

The flow originated at the south end of a high ridge at the head of a minor branch of the Slumgullion drainage. From this point, with an elevation of about 11,500 feet, the flow descended 2,500 feet to the valley of the Lake Fork, four miles distant from the source. The material of the flow now fills the valleys in which it lies to a probable elevation of 150 to 300 feet above the original bottom.

The topographic features of the flow are very pronounced. It is bounded for nearly its entire length by two moraine-like lateral ridges of very sharp outline. Between these the flow is usually lower and characterized by furrows and trenches, knolls and hollows of confused relations resembling those of modified landslide areas or of some glacial deposits.

The material of the flow is mainly a soft, light yellow or nearly white decomposition product of pyroxene andesitic lava and irregular fragments of the same rocks, some of which are fresh, while more are partly altered. The origin of the flow is intimately connected with this decomposed condition of the andesite at its head. It appears that at the end of the ridge mentioned a large mass of andesite belonging to a complex of flows was extensively decomposed, the product consisting principally of opaline silica, hydroxides of iron and alumina and gypsum, forming a soft mealy mass which on saturation with water became a liquid mud. On this mass rested less altered beds of andesite.

It is believed that at a certain time unusual softening of the mass by water caused it to give way, and that the greater part of the visible flow descended at one time, in the manner illustrated by mixtures of soil and rock waste which, on a much smaller scale, frequently flow down ravines or mountain slopes as a result of cloudbursts.

The Slumgullion flow took place before the beginning of the present heavy forest growth and after the glaciation which produced the morainal deposits on the adjacent slopes.

FRANCOIS E. MATTHES,
Secretary

THE ACADEMY OF SCIENCE OF ST. LOUIS

THE academy met at the academy building, 3817 Olive St., Monday evening, May 17, 1909.

Professor W. E. McCourt, of the department of geology of Washington University, presented an illustrated paper on "Diamonds in Arkansas."

Professor McCourt first gave a general account of the properties of the diamond, and an account of some of the famous diamonds of history. Then the general commercial occurrences of the diamond were considered—namely, India, Brazil and Africa, whence the world's supply of diamonds has largely come. Diamonds have also occurred in the United States, some of them to a size of fifteen carats, but nowhere in very large quantities.

In 1906, however, diamonds were found derived from a parent rock in Pike County, Arkansas, near the town of Murfreesboro. The presence of the rock in this region, similar to rock in which diamonds were found in Africa, has been known for some time, and the state survey has mapped one of the areas. The igneous rock is a peridotite which has been pushed up through the Carboniferous and Cretaceous quartzites and sandstones, and in places is covered by beds of Post-Tertiary and Quaternary formations. But there does not seem to have been any metamorphism accompanying the intrusion of this material. This peridotite is dark colored, basic igneous rock which contains olivine, augite, magnetite, mica and perofskite. In some places the rock is exceedingly hard and dense, but in others it has weathered to a yellowish and greenish soft material to a depth of from twenty to twenty-five feet. Covering the region to a depth of a foot or so is a black gumbo soil which contains fragments of the hard peridotite and the country rock.

The work in this region has not been very extensive, but bore holes have been made in several places, one reaching to a depth of 205 feet in the hard rock; several companies have located on the area; and stones to the number of about 600 have already been found. The largest stone is six and a half carats. Some have been cut and are valued at $104 a carat. The colors vary, most of them being white, brown and yellow, though one blue diamond has been found and several black ones.

From these indications this area seems to contain a mass of rock similar to the rock in South Africa. But as to the number of diamonds which may be found deeper in the peridotite, that, said Professor McCourt, is a question which can only be settled by actual mining and testing. The results which have been shown by the more or less spasmodic exploitation, however, seem to indicate a good promise.

Professor Nipher stated that he had been unable to finish his work on electrical discharges on account of recent developments. He has found that the electric corpuscles can be focused by means of a fiber of red glass lying on the film of the photographic plate. When the positive and negative terminals of the influence machine are grounded at different points, he finds evidence that the corpuscles are discharging from the negative line to surrounding bodies. They are also moving from surrounding bodies to the positive line. This refracting device seems to furnish a way of making further studies on electric fields.

The following memorial was adopted in memory of Dr. H. Aug. Hunicke, corresponding secretary of the academy at the time of his death:

Dr. Henry August Hunicke, at the time of his death on April 5, 1909, had been a member of the Academy of Science of St. Louis for rather more than twelve years, during five of which he held the office of corresponding secretary.

His active interest in everything appertaining to the labors of the academy is indicated, not only by his contributions to its scientific proceedings, but also, to an even greater degree, by his active participation in the business of the council, in matters of organization, in the discussion of questions of policy and in the promotion of measures designed to broaden the scope or to increase the usefulness of the academy.

He was an effective speaker, because his outlook and his sympathies were both broad and deep. Although a keen debater, he was uniformly considerate of the feelings of others and never permitted himself to treat his opponent of the moment with anything less than the most perfect courtesy. His spirit was ever helpful, encour-

aging, warmly appreciative of merit or good intent, but he was, nevertheless, quick to detect and to comment upon faults in logic or on errors of any sort. Such criticisms were always without rancor and were delivered with a touch of humor and with so delicate a tact, that, while they enlivened debate, they rarely or never gave offense.

As a councillor, his advice was highly valued, because he looked to the end, being not easily diverted from the main objective nor disposed to waste time over side-issues or trifles, and because he neither underestimated the adverse view nor overstated his own.

In his various capacities, as adjunct professor at Washington University, as a resourceful and able technologist, and as a close student of certain strictly scientific applications of the theory of thermodynamics, Dr. Hunicke enjoyed in full measure the respect of those who were in a position to judge his work, and so achieved his reputation; but in the minds of his colleagues of the university and of the academy, his truest claim to distinction lies in the exceptional qualities of heart and character, which endeared him to his friends, which were a constant inspiration to all who came within the sphere of his influence and of which the memory constitutes a living monument in his honor.

The Academy of Science of St. Louis places this record in its archives as a brief token of respect and as an expression of its sense of the severe loss which the academy and the world have sustained in his death.

Launcelot W. Andrews,
Chas. D. Stevens,
H. A. Wheeler

The academy met at the academy building, 3817 Olive St., Monday, June 7, 1909.

Professor W. E. McCourt, of Washington University, exhibited a number of photographs taken in Onondago Cave, near Leesburg, Mo., and described the formations found there.

Professor F. E. Nipher, of Washington University, gave a verbal account of some of his recent work on electric discharge, stating that his paper on the subject has not yet been completed.

He has recently obtained what have the appearance of shadow images of glass fibers laid across the film of a photographic plate enclosed in a hard-rubber holder, although the fibers were not present. They had been laid across the film of another plate previously exposed in the same holder. When the fibers were present they gave black focal lines on the negative. The after images formed on the next plate were white shadow images. The electrons which came from a highly charged line wire from the negative terminal of a plate glass machine were on the second plate deflected away from the lines upon which they had been converged in the first plate. This indicates that the effect is due to electrons and not to ether waves or ultra-violet light.

Experiments of the same kind with X-rays have given negative results. Previous exposures of plate holders to electrical radiations do not appear to affect X-ray images, although this matter is still under examination.

Later experiments to determine momentum effects around an angle in a wire have been made by placing the angle flat upon a sheet of glass. It is held in place by means of a fine silk thread doubled around the wire at the angle and attached to a helical spring. A photographic plate may be slipped under the wire at the angle. A sheet of black paper is inserted between the film and the wire, and a larger sheet is laid down upon the glass plate. These sheets of paper cut off luminous effects due to the discharge. If these sheets of paper are used a second time during the day, images of the wire due to previous exposures are formed on the plate. The momentum effects previously observed and reported are less marked by this method, and can only be obtained by placing a grounded and laminated condenser plate below the sheet of glass upon which the plate is supported. This deflects the negative particles downward upon the film.

It has also been found that the smooth aluminum wire lying flat upon the sheet of black paper in contact with the film, produces under some conditions an image which shows a sharp system of wave forms. The breadth of the image is about 3 or 4 mm. at the widest part and inappreciably small at the nodal points. The wave-length and position seem to be affected by the angle in the wire and the local geometry of the circuit around the angle. The wave-length is about 2×3.75 cm. The wave forms reverse their positions in a symmetrical way when the direction of the discharge is reversed. It is suspected that the tension on the wire has something to do with these wave forms. When the tension is small they are not observed. There is, however, much remaining to be done in the study of these phenomena.

W. E. McCourt,
Recording Secretary